

## REMARKS

The Office Action dated July 1, 2009 has been received and considered. In this reply, claims 1 and 12 are amended. Claims 1-5 and 7-19 are pending herein. Applicants respectfully submit that the amendments present the claims in better form for allowance. Applicants further submit that the amendments do not add new material, and support for the amendments may be found in the specification and drawings as originally filed. Further, claims 1 and 12 are amended without disclaimer and without prejudice. Applicants reserve the right to pursue the inventions of the originally filed claims and claims prior to this amendment later during the prosecution of this application or during a subsequently filed application. Reconsideration of the outstanding rejections is respectfully requested based on the following remarks.

1. Claims 1-5, 8-13, and 15-18 were rejected under 35 U.S.C 103(a) as being unpatentable over Weismann et al. (6,794,339) in combination with either deBarbadillo, II et al. (4,962,085) or Yoshida (5,206,216) further in combination with Van Buskirk (5,653,806) further in combination with Reeves et al. (2005/0014653). This rejection is respectfully traversed for the following reasons.

The claimed invention is drawn to a process for producing long lengths of layered superconductor. The coated tape is translated through a conversion zone at a rate of at least about 10 meters per hour while oxygen and water vapor are introduced through a showerhead. The claimed invention particularly calls for reacting the water vapor, oxygen, and the metalorganic precursors of  $\text{REBa}_2\text{Cu}_3\text{O}_7$  to form a superconducting coating while translating the coated tape through the precursor conversion zone. Achieving a throughput of at least about 10 meters per hour for an *ex-situ* process is significant in this regard.

There are a number of techniques for forming a superconducting coating on a substrate. These techniques can be classified as *ex-situ* processes and *in-situ* processes. In an *in-situ* process, such as pulsed laser deposition (PLD), sputtering, and metalorganic vapor deposition (MOCVD), growth of the superconducting coating occurs in a single step. *In-situ* processes do not involve reacting water vapor and precursors that have been coated on a substrate. *In-situ* processes are well suited for high-throughput applications as *in-situ* processes can deposit a

superconducting film at a rate of up to 1-5 microns per minute. *See, Paragraphs [0006] and [0011] of the Present Application.*

The chemical reactions that form a superconducting coating using *ex-situ* processes are different from the *in-situ* processes. In an *ex-situ* process, such as metalorganic deposition (MOD), spray pyrolysis, and BaF<sub>2</sub> post annealing, precursors are deposited atop a substrate and subsequently undergo a separate chemical reaction that converts the precursors to a superconducting coating (paragraph [0007] of the Present Application). The conversion reaction required in the *ex-situ* process occurs on the order of 1 Angstrom per second, which is about three orders of magnitude slower than an *in-situ* process. Utilizing different precursor chemicals alters the chemical reaction for conversion to a superconductor material in this inherently unpredictable art. In a particular MOD process, trifluoroacetic acid complexes of rare-earth, barium, and copper are mixed in a solvent and applied to the substrate, such as by dipcoating. In order to form the superconductor layer, the organics are baked off and the precursor material is reacted with water vapor to form a superconducting layer. Alternatively, in a particular BaF<sub>2</sub> post annealing process, a metal containing layer is formed by the deposition of rare-earth, barium fluoride and copper metals. The metal containing layer is oxidized in the presence of water vapor and oxygen to form the superconducting layer.

In the claimed process, the reaction of the water vapor, oxygen, and metalorganic precursors can involve removal of the organic carrier molecules and combining the RE, Ba, and Cu with oxygen in the required stoichiometry to form the superconductor coating. Achieving a quality superconductor coating along the length of the coated tape while translating the coated tape through the precursor conversion zone has particular challenges. Changes in the oxygen or water vapor partial pressures within the precursor conversion zone can affect the reaction rate. In a batch process where the entire coated substrate is placed in the conversion zone while the reaction is carried out to completion, this effect is experienced equally throughout the substrate. However, in a continuous process where the coated tape is translated through the conversion zone, these types of changes can lead to undesirable variability in the quality of the superconductor coating along the length of the coated tape. Furthermore, the current carrying capacity of the entire tape is limited by the tape segment having the lowest current carrying capacity. Thus, a short term fluctuation temporarily reducing the reaction rate could have

disastrous effects in a continuous process, but may not significantly effect the overall quality in a batch process.

Turning to the prior art, the USPTO relies upon Weismann to teach particular portions of claim 1. Weismann discloses an *ex-situ* process including forming a precursor film and heat treating the precursor film at sub-atmospheric pressures in the presence of oxygen and water vapor (Weismann in Abstract). Specifically, Weismann utilizes the BaF<sub>2</sub> post anneal process in which a precursor film consisting of BaF<sub>2</sub>, Y, and Cu is deposited onto a substrate using vapor deposition (Weismann at col. 4, line 59 through col. 5 line 4). The coated substrate is placed in a conversion chamber for the duration of the conversion process. During the heat treatment step, the superconducting film grows at a rate of from about 1 to about 20 Angstroms per second (Weismann at col. 4, lines 20-22). The USPTO states Weismann fails to teach a process utilizing coated tapes. Additionally, Weismann fails to teach a process including reacting the water vapor and the metalorganic precursors of REBa<sub>2</sub>Cu<sub>3</sub>O<sub>7</sub> to form a superconducting coating while translating the tape through the precursor conversion zone, let alone at a rate of at least about 10 meters per hour. Further, Weismann fails to recognize the particular challenges associated with an *ex-situ* process involving a translating the coated tape through the precursor conversion zone.

The USPTO relies on DeBarbadillo or Yoshida to allegedly suggest modifying the *ex-situ* process of Weismann to include translating a coated tape though a conversion zone.

DeBarbadillo discloses a metal superconductor precursor layered on a metal substrate (DeBarbadillo at col. 4, lines 18-31). The metal substrate can include tapes, ribbons, and wire. (DeBarbadillo at Abstract, Fig. 1, and col. 1, lines 1-15). DeBarbadillo teaches an oxidation process of metal precursors, rather than utilizing metalorganic precursors. As previously discussed, the conversion of metalorganic precursors in an *ex-situ* reaction requires removal of the organic carrier molecules through evaporation and burnout. These organic carrier molecules may be involved in side reactions, such as with the oxygen present in the precursor conversion zone, effecting the desired reaction for forming the superconductor coating. As such, DeBarbadillo fails to recognize the challenges associated with *ex-situ* conversion of metalorganic precursors while translating a coated substrate through the conversion zone.

Yoshida discloses an *in-situ* pulsed laser deposition (PLD) method for depositing a superconducting film on a metal tape (Yoshida in Abstract). Significantly, Yoshida teaches that PLD is particularly suited for fabrication of long lengths of tape and can achieve a throughput of about 5 cm/min to 50 cm/min (3 to 30 meters/hour) due to the high deposition rate of PLD (Yoshida at col. 2, lines 60-69). The thickness of the superconducting coating, and thus the current carrying capacity, is dependant on the throughput and the rate at which the superconductor coating is formed. Due to the significant differences in the rate of formation of the superconductor coating between the processes of Weismann and Yoshida, one of ordinary skill in the art would not have had an expectation of success by applying the process parameters, specifically the throughput, of Yoshida to the process of Weismann. Accordingly, the USPTO has not provided a proper motivation to combine the throughput of Yoshida with the process of Weismann.

Further, the USPTO acknowledges that Weismann in combination with DeBarbadillo or Yoshida fail to teach the use of a showerhead to supply oxygen and water vapor. As such, the USPTO relies on Van Buskirk for disclosure of a showerhead for delivery of gases and vapors to a substrate.

The USPTO apparently relies upon Reeves to allegedly suggest modifying the teachings of Weismann, DeBarbadillo or Yoshida, and Van Buskirk to include translating at a rate of at least about 10 meters per hour. Reeves discloses an *in-situ* method including translating a tape through a deposition chamber at a rate of between 0.3 meters/hr and 10 meters/hr (Reeves at paragraph [0063]). Reeves discloses forming the superconductor layer using *in-situ* processes such as PLD and CVD. Similar to Yoshida, due to the significant differences in the rate of formation of the superconductor coating between *in-situ* and *ex-situ* processes, one of ordinary skill in the art would not have an expectation of success from combining the translation rate of Reeves with the *ex-situ* process of Weismann. Accordingly, the USPTO has not provided a proper motivation to combine the translation rate of Reeves with the process of Weismann.

At least some degree of predictability is required to support a finding of obviousness. *See generally*, MPEP §§ 2143.02. *In-situ* and *ex-situ* processes involve inherently different chemical processes, and the chemical reaction of the water vapor with the precursors to form the

superconducting coating is inherently unpredictable. The USPTO suggests that it would be obvious to increase the rate of translation based on the teachings of Reeves (*in-situ* process). However, one of ordinary skill in the art would have recognized that *in-situ* processes and *ex-situ* processes form superconducting films at significantly different rates using significantly different chemistries. Yoshida and Reese clearly suggest that *in-situ* processes with high deposition rates are better suited for fabrication of superconducting wire at high speeds, such as in a method including translating at a rate of at least about 10 meters per hour. The USPTO has failed to show that one of ordinary skill in the art would have expected to obtain a functional product when accelerating the translation rate during an *ex-situ* process. Indeed, based on the conversion rates and absent Applicant's own disclosure, one of ordinary skill in the art would have expected an incomplete conversion and a nonfunctional product when applying the translation rate of an *in-situ* process, such as the one in Reeves, to an *ex-situ* process, such as the one in Weismann or deBarbadillo. Additionally, the chemical reaction required for conversion is inherently unpredictable, and the *ex-situ* processes of Weismann and deBarbadillo utilize different chemical reactions to form HTS material from the claimed MOD process. Therefore, the references fail to provide an expectation of success when reacting water vapor, oxygen, and metalorganic precursors of  $REBa_2Cu_3O_7$  to form a superconducting coating while translating the tape through the precursor conversion zone. In absence of Applicant's disclosure, one of ordinary skill in the art, would have not have expected an *in-situ* process, such as PLD or CVD, to predict translating at a rate of at least about 10 meters per hour using an *ex-situ* MOD process.

For at least the foregoing reasons, Applicant respectfully submits that the presently claimed invention would not have been obvious over the cited prior art. Accordingly, reconsideration and withdrawal of the 103 rejection is respectfully requested.

2. Claim 7 was rejected under 35 USC 103(a) as being unpatentable over Weismann et al. in combination with either deBarbadillo, II et al. or Yoshida further in combination with Van Buskirk et al. further in combination with Reeves et al. further in combination with Manabe et al. or Weinstein. Claim 14 was rejected under 35 USC 103(a) as being unpatentable over Weismann et al. in combination with either deBarbadillo, II et al. or Yoshida further in combination with Van Buskirk et al. further in combination with Reeves et al. further in combination with Ott et al. Applicant respectfully submits that Manabe et al., Weinstein, and Ott

et al. fail to address the deficiencies of Weismann et al., deBarbadillo, II et al., Yoshida, Van Buskirk et al. and Reeves et al. as discussed above. Accordingly, withdrawal of these rejections is respectfully requested as well.

Applicant respectfully submits that the present application is now in condition for allowance. Accordingly, the Examiner is requested to issue a Notice of Allowance for all pending claims.

Should the Examiner deem that any further action by the Applicant would be desirable for placing this application in even better condition for issue, the Examiner is requested to contact Applicant's undersigned attorney at the number listed below.

The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 50-3797.

Respectfully submitted,

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Date

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